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special Roles for Universities?

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**Public-Private Partnerships and Sustainable Regional Innovation Systems:
Special Roles for Universities?**

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Abstract

The notion of Public-Private Partnerships (P3) is ambiguous. This has not stopped the UN and several other organisations from proclaiming these partnerships as a pivotal mechanism for a move towards more sustainable societies. To date, however, little emphasis has been on universities in this connection, and their roles (if any) are still somewhat unclear. So, the question is: What is or could be the role of universities in P3s?

A third mission of universities, often referred to as 'outreach', is increasingly coming into focus. One aspect of the third mission is the role universities is or may be playing in public-private partnerships for sustainable development, and the links and benefits this may provide towards universities fulfilling their first (science) and second (education) missions.

In this paper, the first part is dedicated to the discussion and clarification of the concept of public-private partnerships. The role of universities if and when actively participating in 'life outside the ivory tower' is addressed. These partnerships are also discussed in a regional context. With point of departure in innovation theory, we combine 'sustainable development' with the Regional System of Innovation approach to propose a new concept – Sustainable Regional Innovation System – in which regional initiatives such as Public-Private(-Academic) Partnerships play an integrated role, not least in the context of 'learning and innovation for sustainable development'.

Two cases are presented to underline the importance of what is signified as Public-Private-Academic Partnerships (PPAP); i.e. partnerships, where universities are given - or take on themselves - a specific role. In such partnerships, we argue, mediation is a major function of universities, including both provision of new knowledge and conciliation of opposing views and universities thus act as catalytic and institutionalising entities.

Public-Private Partnerships and Sustainable Regional Innovation Systems: Special Roles for Universities?

1. Introduction

Partnerships emerge through mutual trust and commitment and as a result of the development of social relationships and power relations. The diversity and range of scholarship in the field is immense and include for example partnerships in the US prison system (Schneider, 1999), global partnerships in health and for health development (e.g. Bazzoli, et al., 1997; Buse & Walt, 2000), partnerships for urban governance (e.g. Pierre, 1998), partnerships for environmental management (e.g. Glasbergen, 1998; 1999), and partnerships for sustainable development (e.g. Roome, 2001; Malmberg, 2003).

The term public-private partnership (P3) is thus rather general, is applied to a number of different subjects, and the partnerships are formed due to a multitude of reasons. Some partnerships are local in nature, others national or regional and some are even international. Further, some partnerships are corporatist arrangements while others - such as one of the cases presented and discussed later in this article - produce a set of Government-Business relations that may be termed non-market interaction (Sjöberg, 1993; Sorensen, 1994; Glaeser, 2000; Glaeser & Scheinkman, 2001). This indicates a qualitative distinction from market relations and corporatist arrangements and raises the issue of why such relationships are established, maintained and developed (Lehmann, 2008).

In terms of sustainable development, partnerships, especially Public-Private Partnerships, has become a new buzz-word and should apparently be one of the new pivotal mechanisms of greening, underpinning the shift in regulatory regimes that through political and ecological modernisation has been going on for more than a decade. The World Summit on Sustainable Development (WSSD) in Johannesburg in 2002 promoted actively the establishment of such partnerships, which should revolve around sustainable development as a goal, and the voluntary collaboration between communities, governments, businesses and NGOs to achieve this goal.

In relation to for example environmental services, corporatist-type partnerships may be found in the privatisation and operation of e.g. water and sewage works, wastewater treatment plants etc., and the goal may be to provide same or better environmental service in a more economically feasible way. Often of a local or regional nature, these partnerships are sometimes also supported by the international community through international organisations' programmes. The UNDP initiative "Public-Private Partnerships for the Urban Environment", <http://www.undp.org/pppue/index.htm>, is an example of such. In this context, the partnership can be viewed as involving contractual obligations and relations, and transfer of responsibility.

Other definitions of P3 focus more on collaborative aspects and formation of partnerships as a new form of cross-sector collaboration or as a network between several parties that have common objectives and are united in achieving their goals. In this context, the Copenhagen Centre (which itself can be defined as a public-private partnership) provides a meaningful, albeit broad, definition:

“People and organisations from some combination of public, business, and civil constituencies, who engage in voluntary, mutually beneficial, innovative relationships to address common societal aims through combining their resources and competencies.”
(Nelson & Zadek, 2000:14)

In their own words, The Copenhagen Centre’s partnership definition is that of a ‘social partnership’, i.e. focusing on aspects of social cohesion and economic competitiveness. However, the definition can be equally valid in a ‘full’ sustainability context, and it can also be used in the less broad environmental one, where economic competitiveness is of equal importance but the notion of ‘social cohesion’ is replaced by that of ‘environmental management’. The contents and principles of the partnership will, however, differ and as a consequence, so will the success-criteria.

Often, the major stakeholders in public-private partnerships are identified as being from government, non-governmental organisations, international organisations, and private companies (LaFrance & Lehmann, 2005), who all have their particular reasons for joining or initiating a partnership, and each bringing different competencies and resources to the table. It follows that multi-stakeholder partnerships thus consist of more than two major stakeholder-groups, and may be seen as a new form of governance (Lehmann, 2008).

Increasingly, academic institutions, (universities etc.) explicitly play important roles in partnerships for sustainable development and it may therefore make sense to distinguish between partnerships without and partnerships with strong academia involvement. Further, as academic institutions bring particular resources to the tables of partnerships, the notion Public-Private-Academic Partnerships (PPAP) is more suitable to cover the latter activities, while the notion of public-private partnerships should be left to activities where academia is not directly present.

Furthermore, academia play an important role in innovation systems. In fact, in many innovation studies there is a strong focus on high-tech, science-based innovation and on the interactions between big firms and universities and other research organizations. But universities are not only important in innovation systems dominated by science-based production. There are many different connections between universities and the societies they work in. They provide firms with employees with science based educations, they produce new scientific knowledge, which firms can use and they cooperate with universities in research and other ways as well. Universities also functions as mediators and translators in such partnerships (Lehmann et al., 2005). Universities are increasingly recognized as key actors in national innovation systems. Recently the so-called third mission of universities (in addition to research and teaching) has drawn attention to a diverse and broad set of relations between universities and the surrounding society. Third mission activities are “concerned with the generation, use, application and exploitation of knowledge and other university capabilities outside academic environments” (Russell Report, SPRU 2002). Also the so-called Mode-2 type of knowledge production leads to new relations and closer interaction between universities and society (Novotny et al., 2001).

This gives rise to the discussion of whether Public-Private-Academic Partnerships should be seen as regional initiatives or can be better described and understood through an innovation system approach.

2. Systems of innovation.

The concept of “systems of innovation” was introduced in the 1980s to emphasize the interdependence and interaction between technical and institutional change in the process of development. The main idea behind the concept is that the innovation performance of an economy (nation, region, city) depends not only on how its individual firms and organizations perform, but also on how they cope with change and interact with each other and with the financial and public sectors.

There are narrow and broad versions of the innovation systems approach to economic dynamics. In the narrow approach, the focus is on the research and development system and on high-tech activities and science-based production. In the broad version, innovations are also seen as anchored in the everyday activities like procurement, production and marketing in all kinds of firms, organizations and sectors, so that innovation includes small, incremental improvements of processes and products as is also often found in environmental public-private partnerships.

Within the broad conceptualization of innovation systems, there are at least three important propositions. First, specialization in terms of production, trade and knowledge is important for innovative performance. The focus is on the co-evolution between what countries and regions do and what people and firms in these countries and regions know how to do well. This proposition implies that both the production structure and the knowledge structure will change only slowly, and that such change involves learning.

Second, some of the elements of knowledge are localized and not easily moved from one place to another. A central assumption behind the innovation system perspective is that knowledge is more complex than information, and that it is not always codified or even possible to codify but also includes tacit elements (Polanyi, 1966). Important elements of knowledge are embodied in the minds and bodies of agents, in the routines of firms and, not least in the relationships between people and organizations (Dosi, 1999). This makes knowledge spatially sticky so that it to some extent adheres to the place where it was created.

Third, relationships and interactions between people and organizations matter. The relationships serve as carriers of knowledge, and the interactions as the process by which new knowledge is produced and learned. This assumption reflects the fact that neither firms and knowledge organizations nor people innovate alone. The crucial point is that interactions between people and organisations have the potential to combine different kinds of knowledge, insights and competences in new ways and that this supports innovation.

Characteristics of interaction and relationships may be called ‘institutions’; institutions are informal and formal norms and rules regulating how people interact (Johnson, 1992; Edquist and Johnson, 1997; Scott, 2001). The institutional approach implies that history and context make a difference when it comes to how agents interact, learn and innovate. An understanding of innovation processes is not possible without at least some grasping of how institutions shape interactive learning and innovation.

2.1 Regional Innovation Systems

When searching for suitable territorial/spatial bases of PPAP innovation systems, we should accept that there are many possibilities and that there is no ideal territorial base where

innovation will always flourish. First of all, we should look for a geographical area that shares institutional characteristics that lead to frequent, intense and high-quality interactions. We should also look for an area with a certain degree of production and trade specialisation, namely an area where, over time, people and firms have become good at doing certain things and acquired a production and competence profile of some sort. Accumulated competence contributes to specific interaction characteristics for the area in question and impinges on the processes of innovation.

Furthermore, we should look for an area with a common knowledge infrastructure, with governance structures and with some kind of public policy routine; we should look for an established polity, including policies affecting learning, innovation and governance directly and indirectly. Finally, we should look for an area that over time has acquired specific demand characteristics that to some extent match its specialisation pattern and enable different kinds of organisational interactions.

A spatial delimitation with all these characteristics is not easy to find. Small and reasonably culturally homogenous nation-states seem to be obvious candidates as “national systems of innovation” (Lundvall et al., 2002). Many types of regions also have some or most of the characteristics identified above; hence, the lively research about “regional systems of innovation” (Cooke, 1992; Asheim & Gertler, 2005). Cities may also possess many of the characteristics, which form good innovation system, and the usefulness of the notion of “city systems of innovation” has been proposed by Johnson & Lehmann (2006) and Johnson (2007).¹ Finally, a local community or a group of such communities may also constitute an interaction area in the way hinted at above, and the “local system of innovation” is now increasingly proving to be a useful concept in development theory and policy (Cummings, 2005).

Regional systems of innovation “can be thought of as the institutional infrastructure supporting innovation within the production structure of a region” (Asheim & Gertler 2005) and here we would add environmental management performance and governance. Such innovations are produced with the help of regional networks of innovators, regional clusters and industrial districts. As an interactive process innovation is very often regionally contained since it depends on combining tacit knowledge with codified knowledge and learning by doing, using and interacting with more science based learning, which requires face-to-face contacts and trust-based relation. This is supported by the proximity between actors and the traits of common culture that sometimes exists within a region.

Since universities, because of their third mission and the growing importance of Mode-2 knowledge production, more and more are supposed to cooperate not only with science-based high-tech firms but also with SMEs and other organizations engaged in low-and medium tech activities they are also increasingly regarded as vital drivers of regional growth and development. They are becoming crucial elements in regional innovation systems. Universities are now not only national institutions meeting the needs for science and higher education for the country as a whole. They have come to play crucial roles as “knowledge hubs” for specific regions including the ones without very much science-based production. Sometimes “regional universities” have been established because of strong pressure on the national government from local and regional firms and labour market organizations, branch organizations, local and regional parliaments, etc.

¹ In fact, already Giovanni Botero (c. 1544-1617) discussed and praised the innovative properties of cities.

2.2 Partnerships as systems of innovation

A broad range of third mission activities tends to anchor universities more firmly in their regions involving a range of constituencies. This lead van Kerkhoff & Lebel (2006) to provide a view-point not too dissimilar to the one presented here, namely:

*“(...) we reached a contrary view of the world, one in which research, politics, researchers and publics are intertwined in a constant struggle of justifications, explanations, and decisions in an uncertain and complex world. These questions encourage us to look at the relationships between research-based knowledge and action as arenas of **shared responsibility**, embedded within larger systems of power and knowledge that evolve and change over time. This conceptualization offers a more appropriate starting point for understanding the role of research in sustainable development than the conventional model of trickle-down, transfer and translation.”* (van Kerkhoff & Lebel, 2006:473; emphasis added).

These arenas (of shared responsibility) can be coined as Public-Private-Academic Partnerships (Lehmann, 2008), which eventually also acts as parts of regional systems of innovation:

“Stakeholders from some combination of public, private, academic and civil constituencies, who engage in voluntary, mutually beneficial, and innovative relationships to address and build natural, human & intellectual, production and social potentials through combining their resources and competencies.”

The following figure (Figure 1) show how this conceptually can be understood with an outset in environment, technology and collaborative projects and ending in governance and sustainability. The green triangle signifies approaches to sustainability related problems, and the red triangle and a) through c) signifies approaches to Public-Private-Academic Partnerships.

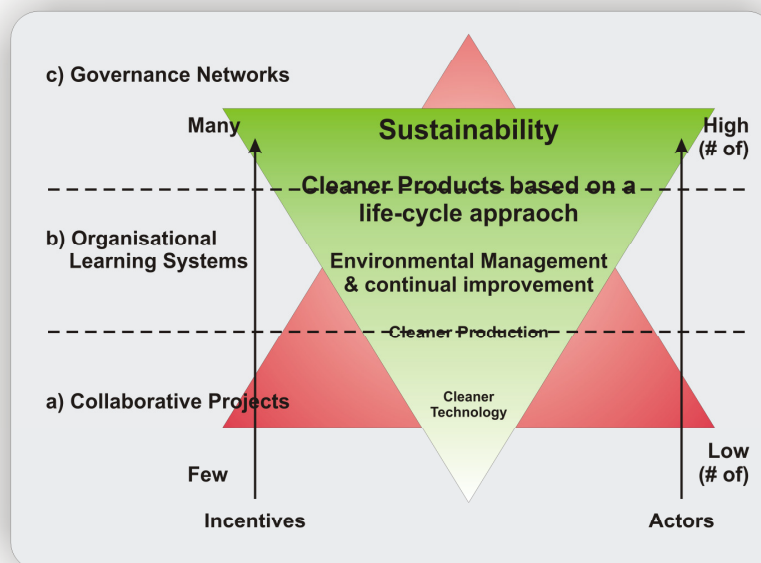


Figure 1 The Greening Triangle and collaborative P3s (red triangle).

The division of activities into three levels that mutually are non-exclusive though signify differences in work on different partnership-levels in terms of time, commitment, member diversity, and ease of entering and/or leaving the partnership. These levels are:

- a) collaborative projects
- b) organisational learning systems, and
- c) governance networks.

“Collaborative projects” are defined as being limited in time, commitment may be relatively small, the range of partners is limited and they can more easily be replaced, i.e. enter or/and leave. At the second level is “organisational learning systems”. Here, the commitment is necessarily higher; partners are challenged and may as a result start ‘doing business’ differently, implementing changes in their respective organisations. While the diversity of partners may not necessarily be higher than in a), the inter-dependency is, and outcomes may be negatively affected should partners decide to leave. At the final level, governance-networks are found. This is where institutional changes may occur and ‘rules of the game’ begin to change, but they will not do so without very strong trust and commitment from a wide variety of partners, both in terms of developing new rules and in ‘playing’ by them. Time-wise, this type of partnership requires more than the categories a) and b), and may in many cases be building on these.

3. Two cases of partnerships

In Denmark, several cases of quite similar partnership approaches exist. The first were formed in the early nineties while others have more recently come to life. In the following, two cases of these types of partnerships are presented.

The first is Green Network, which is generally accepted as the inspiration and role-model of later networks. The second case is Sustainable Business Forum North Denmark that while also inspired by Green Network and utilising many of the tools it developed, is also different in the sense of which actors take an active and leading role and who initiated the network.

3.1 Green Network

The story about Green Network begins in 1992 when the seed for the first environmental networks with strong and binding participation from both the public and the private sectors in Denmark was laid down. The then National Agency for Trade & Industry wrote out a competition with the aim of establishing a network that was to be the Danish showcase on environmental knowledge and technology. From that competition, one of the most successful networks (Lehmann, 2006) in Denmark was established, namely the Green Network in the county of Vejle. It did not win the competition nor did it become the international showcase in the original sense (Lehmann et al., 2005). Quite a lot of work had however gone into establishing the co-operation and the network, and neither the involved public sector nor the private companies were prepared to just write that off. Instead, a re-constitution took place, making the network more local in nature, and the promotion of environmental activities were preferred instead of the previous (due to the competition guidelines) focus on economy and export (Erik Ørskov, Personal Communication, 2003; Lehmann 2008). Green Network thus became a public-private partnership focused on show-casing that - locally as well as regionally - environmental considerations and economic gains as well as the private sector and the public authorities could indeed walk hand-in-hand and thus contribute to greater

societal benefits. From the outset and today still, the major drivers in the network are the private companies and the public authorities. This is reflected both in the network organisation and in the activities taking place, showing that the benefits must come to those who commit resources.

The pivotal mechanism in the workings of the Network was to be a recognised (through diploma and Flag), seminal form of green accounting (statement) and environmental management system. This was developed through a collaborative project with participation from several local companies, the local municipalities and the Danish consultancy firm COWI A/S. The concept revolved around a dialogue-based approach to local governments' obligations of granting environmental permits and inspecting companies.

In June 1994, the Network was formally established with organisation, by-laws, activities, and business plan. A three-tiered membership was established reflecting both obligations and responsibilities towards the Network and its activities. Vejle County, the municipalities of Vejle, Horsens, Kolding, Fredericia and Middelfart constituted the public sector (O-members), approximately 30 companies the most active of the private sector (V-members), and a similar number of other organisations were part of the Network as so-called Interested Parties (I-members). The economy of the network was and still is based partly on membership fees² and partly third-party funding for various projects.

The network has been able to move from an initial focus on environmental management to today's integrated approach on sustainability (Lehmann, 2006; 2008) all the while it has also expanded its membership base and its outreach. Academia played a small part in this move through active involvement in various seminar and workshop activities calling for enlarging the focus beyond environment only. In 2001 and 2002, faculty from Aalborg University, (a university located outside the Green Network region) were invited to participate in the strategic reform of the network with the goal of formulating a new network strategy that should encourage and recognise organisations' work with occupational health & safety and social accountability alongside that of environmental management.

The strategic move from 'environment' to 'sustainable development' was a reality in early 2004 and not much later the Green Network toolbox of simple managements systems and back-pack of supportive activities were enlarged in order to enact the new sustainable development strategy. A brief overview of activities based on Lehmann's (2006) categorisation is presented in The Danish administrative structural reform, which took place in 2005 and '06 and took effect 1 January 2007, rattled the network's cage. The network had based its formation and its secretariat on the county. Its abolishment (incl. its strong economic support), could have meant the end of Green Network. This, however, has not at all been the case.

In southern Denmark, four networks are now to a varying degree active. The Green Network is the most active and has in fact expanded its secretariat in order to be able to honour the activity level of its members. The network is now based on 6 municipal O-members and approximately 280 member-organisations (see Figure 2 for the Network's geography as of today), and these are still the major driving forces.

Table 1.

² Up until the Danish structural reform, this included the county's contribution towards the running of the network's secretariat.

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Table 1 Overview of activities in Green Network

| Category | Activities |
|-----------------------------|---|
| Statements | Process consultants (EMS, OHS, CSR), dialogue, Review & Certification (of statements), |
| Continued Education | Process consultants, short courses, seminars & workshops |
| Projects | Examples: Environmental management in agriculture, Green Purchases, LCA manual, social reporting, environmentally friendly transport, workers' health, toolbox on 'waste and re-use', guide on chemicals, establishment of Key2Green. |
| Information & Communication | Newsletters, press releases, homepage, diploma events, speeches, yearly green account |

The new regional authority, the Region of Southern Denmark, is increasingly showing an interest in using the networks' expertises, drive and commitment to expand sustainability initiatives geographically as well as conceptually. The interest is backed by a commitment of considerable human as well as institutional and economic resources, but does not constitute the same outright regional support as was the case before the reform (where the County of Vejle supported the network).

The Region has, however, pushed for stronger university involvement, not least by encouraging and supporting the networks and the university in the region to come together in a strategic effort to enlarge the networks' membership base, and in jointly developing new projects aimed at innovating both the networks' various toolboxes and the university's related educations. These projects are just now (early 2008) getting off ground, but will eventually show whether if Green Network will stay a Public-Private Partnership or turn into a Public-Private-Academic Partnership.

3.2 Sustainable Business Forum North Denmark

In one of the other new Danish regions, Region North Jutland, financial support to a somewhat similar network – Miljøforum Nordjylland (Sustainable Business Forum North

³ The local government reform created a new map of Denmark. 98 municipalities were replacing the previous 271, the 13 counties were abolished and five new regions created, and a new division of tasks between local, regional and state authorities took place. Cf. e.g. http://www.sum.dk/publikationer/government_reform_in_brief/index.htm.

Denmark; SBFND) – was obtained through two grants; one from the regional Growth Forum (Vækstforum), and another from a so-called Science and Enterprise Network, which demands strong academic involvement in projects it supports. In that sense, this network is therefore not a public-private partnership but rather a public-private-academic partnership, and its mission is to act as a catalytic entity for the production and dissemination of appropriate and useful knowledge, the development of new business opportunities and the creation of a better environment (MFN, 2007). The aim of the network is to promote business development through greening – the catch phrase is “Clean & Competitive” (Riisgaard, 2008). See Figure 2 for geographical coverage.

The network was established in late 2006 on the basis of a group of quality & environment managers working in the region and meeting informally from time to time. The wish was to enlarge and formalise the meetings within this group of professionals as well as include new actors in the work. It had been tried before, with the county as the leading initiator but always failed. From the outside, the network could be viewed as quite similar to the networks in southern Denmark. It is organised around a number of members from the public and private sector in the region and supported by a secretariat. Two important differences, however, make the network unique: the strong involvement of academia (from Aalborg University, AAU), and the lesser commitment and involvement from municipal authorities.

In fact, the municipal authorities in the network are not pivotal and the activities are neither built around the authorities’ obligations of inspecting private companies and issuing them permits, nor around any dialogue between the public and the private sector that these obligations may or may not produce. Instead, the technical departments of the local government members are to a much larger degree on the receiving end of the network’s services, and any role the municipalities may have is to a much larger degree associated with their business development functions. According to the coordinator of the network, who is adjunct professor at AAU, the pivotal mechanism is in fact the contact to Aalborg University. This contact (in Danish, Forskerkontakten) includes student projects, researcher involvement in development projects and speeches and lectures at all seminars and workshops. The strong connection results in professionally and technically well-founded activities, but also stronger public-private-academic dialogue.

Besides being one of the main initiators of the network, the strong university involvement is also evident when looking at the steering committee (currently eight persons). This has participation by three other faculty members from the university (one full professor and head of department, and two associate professors). Further, the university is a full member of the network, and utilises its activities to connect (theoretical) university education with practical knowledge and activity.

A brief overview of the activities in the network can be viewed in Table 2. These activities all have a tendency to be rather short term (at most 6 months) and based very much on experience exchange and on connecting the various actors. Any longer term interaction between for example a company and university faculty is therefore up to the partners themselves. In that sense, the network functions as some sort of brokerage arrangement for knowledge transfer (see e.g. Malmberg, 2004).

Table 2 Overview of activities in SBFND

| Category | Activities |
|----------|------------|
|----------|------------|

| Category | Activities |
|-----------------------------|--|
| Cleaner Products | support to review and policies (EMS), dialogue |
| (Continued) Education | short courses, seminars and workshops, problem based learning (as taught at AAU) |
| Projects | Seven master-level theses and projects; Lean, TPM; food product safety; ECO-design |
| Information & Communication | Newsletters, press releases, homepage |

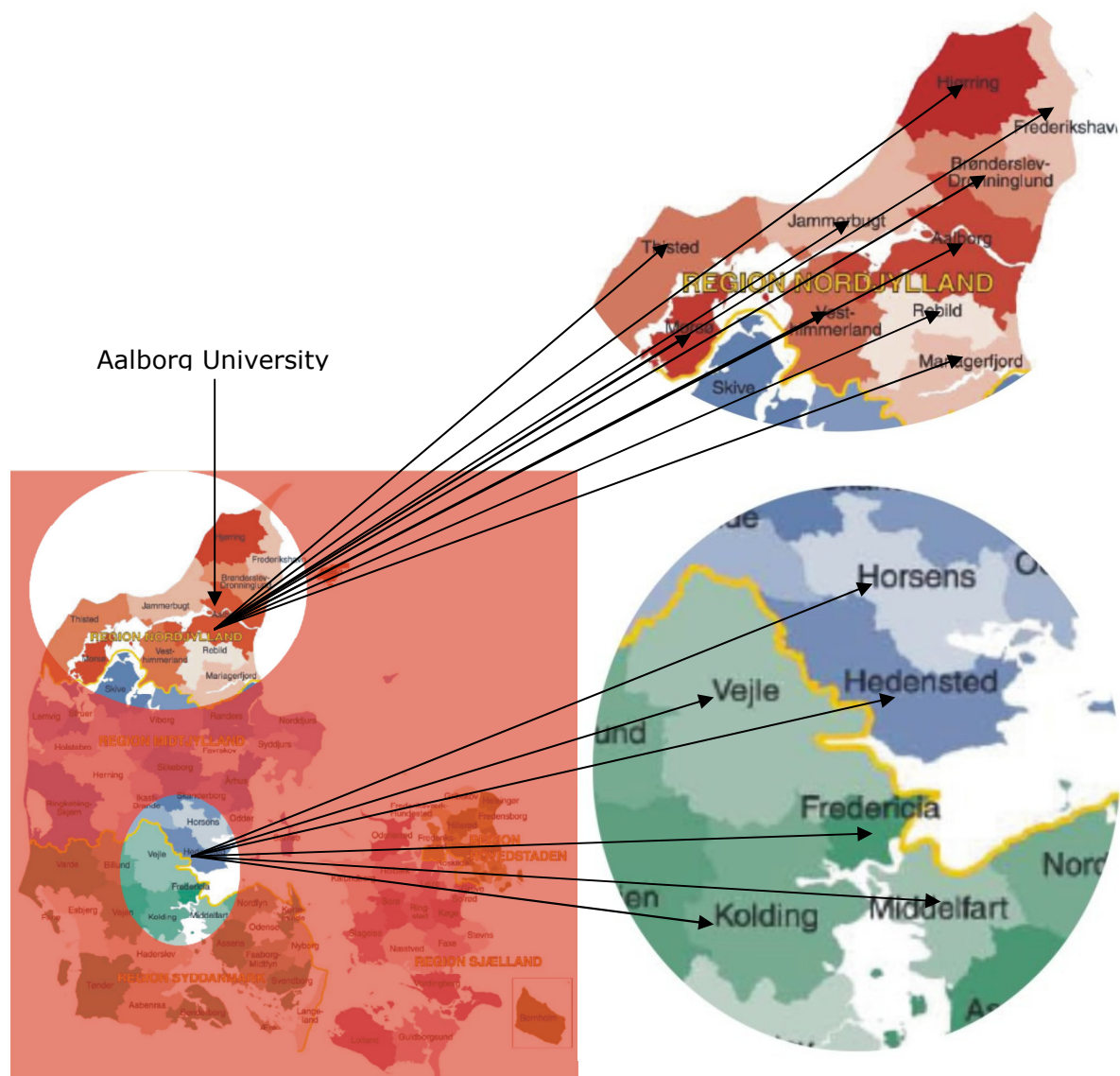


Figure 2 Geography of the Green Network region: Horsens & Hedensted in Central Denmark Region, and Vejle, Fredericia, Kolding & Middelfart in Region of Southern Denmark; and of the SBFND region covering all municipalities in the Region of North Denmark.

4. Discussion

As one of the options in the pursuit of sustainable development, the notion of Public-Private Partnerships emerged and at the 2002 World Summit for Sustainable Development (WSSD)

in Johannesburg, it was concluded that ‘partnerships’ should become a decisive factor in achieving global sustainability. As with the Rio Conference in ’92, academics played a substantial role in writing background papers etc. but were later squeezed out when politicians took over:

“And this remained the pattern with WSSD 2002, even though WSSD 2002 highlighted the importance of partnerships. Emphasis was, however, placed primarily on partnerships between business, government agencies and non-governmental organisations, rather than with academics.” (Fincham et al., 2005:24)

If that is really the case, what roles may universities play in partnerships for sustainable development? Do universities have something special to offer and what may it be? Are there any substantial experiences to fall back on? Much anecdotal evidence seems to suggest this, cf. for example Gaardhøje et al. (2006), AAU (2001; 2002), Fincham & Korrûbel (2003), Fincham et al. (2005), Jamison & Muchie (2005), Jeppesen et al. (2005), Hansen et al. (2005), Hansen & Lehmann (2006), and Lehmann & Fryd (2008).

Further, the practitioner and research conferences EMSU (Environmental Management for Sustainable Universities) both in 2004 (in Mexico) and in 2006 (in Wisconsin, US) produced much literature and debate on this particular topic and presented various partnership experiences from all over the world.

As we have seen in the cases described above amongst these there are activities, which can be described as public-private partnerships or public-private-academic partnerships depending on the degree and character of university involvement. The two networks presented in this article both focus their efforts on addressing issues of sustainable development.

So PPAPs are there and in various ways they may constitute crucial parts of innovation systems.

4.1 Sustainable Development

After more than 20 years the definition of sustainable development of the Brundtland Report still expresses very well what most people put into the term i.e. development which meets the “needs of the present without compromising the ability of future generations to meet their own needs” (WCED, 1987).

To achieve sustainable development investments need to be done in four different but related types of capital: natural capital, human and intellectual capital, production capital and social capital. Mankind depends on these capital stocks and without their maintenance the ability of future generations to fulfil their needs is impaired. In short, these four capitals may be described in the following ways⁴:

- *Natural capital* refers to natural resources and ecosystems. In addition to renewable and non-renewable natural resources it also includes geographical factors like climate, disease

⁴ A note on the terminology: It may be problematic to use the term ‘capital’ in the way we do here since it often refers to a stock which can grow or decline. Because of the diversity, incomparability and complexity of the elements in these four stocks it is often impossible to measure the size and change of them in meaningful ways. For example, social capital, which is defined as a set of rules, habits and norms is very difficult to imagine as a stock and how would one aggregate climate, oil and biodiversity into a single stock of natural capital? However, the use of the notion of capital has become quite common in these connections and we may think of it rather as a collection of different things than as a homogenous stock.

ecology and distance to the coast (for example, if a country is landlocked or not) which recent empirical research has shown to be strongly correlated with development (Sachs & Mallaney 2002).

- *Human and intellectual capital* refers to the health, education, knowledge and competence of people.
- *Production capital* is the stock of buildings, tools, machines used in production of goods and services. This is what economists traditionally refer to as capital.
- *Social capital* is composed of the institutions, which form the language, trust and networks that make continual social interaction possible.

One implication of envisaging sustainability in terms of these four capitals is that it has to be looked upon as a process and not as a state of balance or equilibrium. Even if society would aim at keeping natural capital, social capital and production capital as they are, i.e. just reproducing the present situation, human and intellectual capital would change. Knowledge never rests. When time is let into the picture production, consumption and social interaction implies new experiences, which results in knowledge change through learning and forgetting. Development is, thus, inevitable and sustainable development requires that the human and intellectual capital is further developed and applied to the maintenance and change of the three other capitals as well. Introduction and utilization of new or at least recombined knowledge into society is called innovation and innovation is the only key there is to sustainability.

4.2 Sustainable Regional Innovation Systems and arenas of shared responsibility

Sustainable development depends on global factors (like CO₂ emissions, climate change, pollution of the oceans) and regional/local factors (loss of biological habitats and recreational areas, and water and air pollution). Some of the factors (like climate change and loss of biodiversity) affect all geographical levels. The possibilities to make development more sustainable by changing human actions and behaviour are, however, not neatly connected to the geographical/administrative level on which the problems emerge or have their impact. Governance and policies are conducted at local, regional, national and global levels and sustainable development depends on actions on all these levels.

This means that regional policy-making and governance is interesting from a sustainability point of view, not because these problems are predominantly regional but rather because it is often feasible to attack them at this level. Often we find universities mediating these pressures on the companies and translating the content thereof to the members of the partnership. In some regions it may simply be possible to make political decisions and create governance structures that address sustainability issues for example by stimulating specific technical, organizational and institutional innovations. The literature about regional systems of innovation as well as the cases of partnerships of the type discussed in this article attests to that.

In another paper we have discussed the concept of a sustainable innovation system, which was defined in the following way: *A Sustainable Innovation System is constituted by human, natural and social elements and relationships, which interact in the production, diffusion and use of new and socially, environmentally, economically and institutionally useful knowledge that contributes to sustainable production and consumption patterns.*

Arguing that the problems of sustainable development (as well as the solutions to these problems) are crucial to future PPAP and the innovations fostered by these, we suggest the notion of *sustainable regional innovation system* to denote regional innovation systems, which include significant public-private-(academic) partnerships that address issues of sustainability. Building sustainable regional innovation systems implies to introduce and support sustainable development at all levels (not only the level of the home region) as a responsibility and a political goal and to support to establish new governance structures like public-private-academic partnerships with a sustainability agenda.

The two partnerships presented within this article are both examples of efforts to build considerable social capital by utilising (and creating) human & intellectual capital in order to move towards more sustainable regions. They are both arenas of shared responsibility. In one arena, the public and private sector play leading roles and have established a governance network, but from time to time bring in academia to create innovations and move from one level of the Greening Triangle, cf. Figure 1, to the next (from environment to sustainability, for example). In the other arena, it is the university that plays the leading role in getting the public and the private together. As both approaches are geographically limited it makes sense to include them as aspects of special types of sustainable regional innovation systems. However, as they are time-wise very different (one is more than 14 years old, the other only 2) and have different outsets (one comes from the public-private, the other from the private-academic), it is difficult to say whether or not they eventually will converge into a similar type partnership and thus provide the same functions to sustainable regional innovation systems.

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